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Yield Characteristics of *Mutiara Merah* Rambutan Varieties (*Nephelium lappaceum*) Planted in Marginal Soil

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ABSTRACT

The study was started to assess the early performance of rambutan yield characteristics planted on marginal sandy tin-tailing soil. The experiment was carried out for one year in a plot of 4-year-old rambutan cultivar at MARDI Kundang, Rawang, Selangor, Malaysia. Varieties of *Mutiara Merah* were used. Data from the plants as a measurement of yield characteristics was recorded. *Mutiara Merah* proved that it can be well-yield and cultivated on sandy tin-tailing soil. *Mutiara Merah* showed that it can be planted and farmed effectively on sandy tin-tailing soil, according to the results of the previous research. It can grow and be useful in boosting rambutan yield. Taking into account the fruit yield parameters as well as yield character components parameters such as fruit weight, seed weight, fruit diameter, flesh thickness, brix, and flesh weight, it can be concluded that rambutan cultivation in marginal tin-tailing soil was found promising for producing higher yields. More field studies are needed to standardize agro-techniques and establish the fertilizer requirements of chemical and organic fertilizers for higher yield in other marginal soils such as peat, bris, and acid sulphate soil, as well as create various value-added products to utilize excess produce.

Keywords: Rambutan; Preliminary study; *Mutiara Merah*; Marginal soil; Yield; Fruits.

1. Introduction

Rambutan (*Nephelium lappaceum* L.) is an underexploited fruit of the humid tropics (Bhattacharjee et al., 2022). The Malay Archipelago, which encompasses Indonesia, Malaysia, and southern Thailand, is home to rambutan. It is extensively grown in Malaysia and Thailand. Northern Australia, the Philippines, Sri Lanka, India, Madagascar, Costa Rica, Congo, and some South American nations (Tripathi et al., 2014).

Rambutan is grown in almost every state in Malaysia, but primarily in Perak, Pahang, Kedah, Kelantan, Johor, and Terengganu (Pohlan et al., 2008). The demand for the rambutan commodity continues to increase but is not offset in terms of production which is declining every year. The cultivation of rambutan plants has not been carried out intensively so the production and quality are not optimal (Yuniastuti et al., 2022). The delicate, sweet, and delectable meat is translucent. The rambutan is a refreshing treat in Malaysia's sweltering, humid conditions. *Mutiara Merah* is one of the hybrid rambutan cultivars created by a team of Malaysian Agriculture and Development Institute (MARDI) experts. Rambutan *Mutiara Merah* is a perennial tree that grows to a height of 10 to 12 meters (Johari et al., 2021).

Growing methods for rambutan cropping have not been well studied under local conditions; however, the selection of certificated vegetative propagated planting material, irrigation facilities, the proper pruning method, and adequate harvest and post-harvest activities will determine rambutan orchard success (Vanderlinden et al., 2004). Thailand and Malaysia are the main producers of raw rambutan, but Thailand also ships a large amount of canned rambutan to Asian and European countries (Karunakaran et al., 2016). Rambutan cultivation is expanding in Indonesia, Malaysia, Australia, the Philippines, and Hawaii (Karunakaran et al., 2016). The study was started to assess the early performance of rambutan yield characteristics planted on marginal sandy tin-tailing soil.

2. Methodology

(a) Experimental site

The experiment was carried out in a plot of 4 years old rambutan cultivars at MARDI Kundang, Rawang, Selangor, Malaysia. The site was located at 3.2719° latitude N and 101.5144° longitude E. The daily temperature during the experiment was in the range of 30–40°C. The research station received an annual average rainfall of 600 mm on 30 rainy days distributed from September to November. The soil was sandy tin-tailing with low pH and low availability of Nitrogen (N), Phosphorus (P), and Potassium (K).

(b) Planting materials

Varieties of rambutan *Mutiara Merah* at age of 4 years old were used in a fully randomized design horizontally on raised plots at a spacing of 10.0 m between seedlings and 10.0 m between rows triangularly.

(c) Data of yield characters

The number of fruits per plant was recorded for the whole year of 2022. The yield parameters viz., fruit weight (gm), seed weight (gm), and flesh weight (gm) were measured using a digital scale meter. Flesh thickness (mm) and fruit diameter (cm) were measured using a caliper. Flesh Brix was recorded by squeezing the fleshes to produce the juice and measured using a portable brix meter. The results of the study were analyzed and discussed in the paper.

(d) Experimental design and data analysis

The experimental design was a Complete Randomized Design. Analysis of variances was carried out to detect significant differences between the parameters. The means of the measured variables were compared by using the appropriate procedure of the Statistically Analysis System (SAS) at the Duncan test ($P<0.05$).

3. Results and Discussions

(a) Fruits number

Table 1 states yield statistics on fruits per plant/year. Sample 3 has the most fruits (582 per plant), while Sample 4 has the fewest fruits (97 per plant). *Mutiara Merah* demonstrated that it can be planted and farmed successfully on sandy tin-tailing soil (Khairol et al., 2023). Tree age plays an important role in fruit quality, but studies to determine its effect are rare in fruit crops (Rasheed et al., 2022). Fruit color is critical not only for optimum aril weight but also for optimal fruit quality (Pohlan et al., 2008). It is critical to develop a suitable fertilization program so that nutrient treatments result in the constantly increased output of high-quality produce (Pohlan et al., 2008). Rainfall and adequate soil wetness are required for appropriate fruit filling and quality. Otherwise, appropriate humidity is also essential for fruit flavor (Tripathi & Karunakaran, 2013). Therefore, it is necessary to breed rambutan plants through the application of in vitro culture to overcome the problem. It is necessary to increase the number of superior rambutan fruit seeds in order to meet the increasing demand for rambutan fruit (Yuniastuti et al., 2022).

(b) Weight and diameter of fruits

Table 1 also includes a summary of fruit weight factors. It demonstrates a substantial variation in the weight of the observed between the samples. Sample 2 has the greatest fruit weight with 47.50 gm/fruit when compared to other therapies, while Sample 3 has the lowest fruit weight with 29.80 gm/fruit. Table 1 also includes a summary of the

berry diameter metrics. Sample 4 provides the largest fruit diameter measurement of 5.92 centimeters. Unfortunately, sample 3 had the lowest significant value of 4.57 centimeters. The diversity of rambutan can be seen from the plant's structure and the characteristics of the fruit (Putri et al., 2022). The dry situation can cause high acidity, small edible amounts, poor taste, and smaller produce size and weight (Tripathi & Karunakaran, 2013). The significance of the location effect was restricted for some traits, such as color, fruit girth, or aril to fruit weight, implying that for some traits, intrinsic varietal differences are mirrored in tree-to-tree differences that surpass differences between locations (Vanderlinden et al., 2004). Edible coatings can be used to extend shelf life and improve the marketability of rambutan, reducing postharvest losses and facilitating fruit exports (Sun et al., 2023).

Table 1. Yield parameter on fruits number, weight and diameter of *Mutiara Merah*

Sample	Parameters		
	Fruits number/plants	**Fruit weight (gm)**	**Fruit diameter (cm)**
1	391.00	40.79	5.28
2	260.00	47.50	5.59
3	582.00	29.80	4.57
4	97.00	46.52	5.92
5	365.00	37.90	5.39
Mean	**40.50**	**5.35**	**339.00**
S.DEV	**7.19**	**0.50**	**178.35**

(c) Seed weight and flesh thickness

Figure 1 shows that there is a substantial variation in seed weight. Sample 1 has the greatest seed weight parameter of 2.73 grams and sample 4 has the lowest seed weight parameter of 2.07 gm when compared to other interventions. Rambutan seeds are a treasure trove of beneficial lipids (Bhattacharjee et al., 2022). The diversity of rambutan is relatively high, to increase the validity of the diversity, it is necessary to know its morphological and genetic characteristics (Putri et al., 2022). The fruit's edible part is a fleshy, translucent white sarcotesta formed by an integument encircling a single oblong seed (Goenaga & Jenkins, 2011). When the amino acid makeup of the protein in rambutan seed is compared to that of the FAD reference protein, the rambutan seed protein is found to be of high quality (Augustin & Chua, 1988). With various ages of development of the rambutan fruits and diverse growing circumstances for plants, differences in the fat level and fatty acid makeup of the seeds can be anticipated (Augustin & Chua, 1988).

Figure 1 also depicts the variation in the thickness of rambutan fleshes. Sample 2 has the greatest significant measurement of flesh thickness (0.92 cm), followed by samples 4 and 5, and samples 1 and 3 have the lowest significance (0.77 cm). The meat (aril) is white or rose-colored, translucent, juicy, acid, sub-acid, or fragrant, and 0.4-0.8 centimeters thick (Tripathi & Karunakaran, 2013). The essential chemicals in Rambutan edible components account for the fruit's substantial nutraceuticals qualities (Bhattacharjee et al., 2022). Generally, the peel and seeds exhibit higher antioxidant activities and bioactivities as there are more bioactive compounds present. Phenolic and

flavonoid compounds are responsible for the antioxidant activities and other biological activities (Tsong et al., 2021).

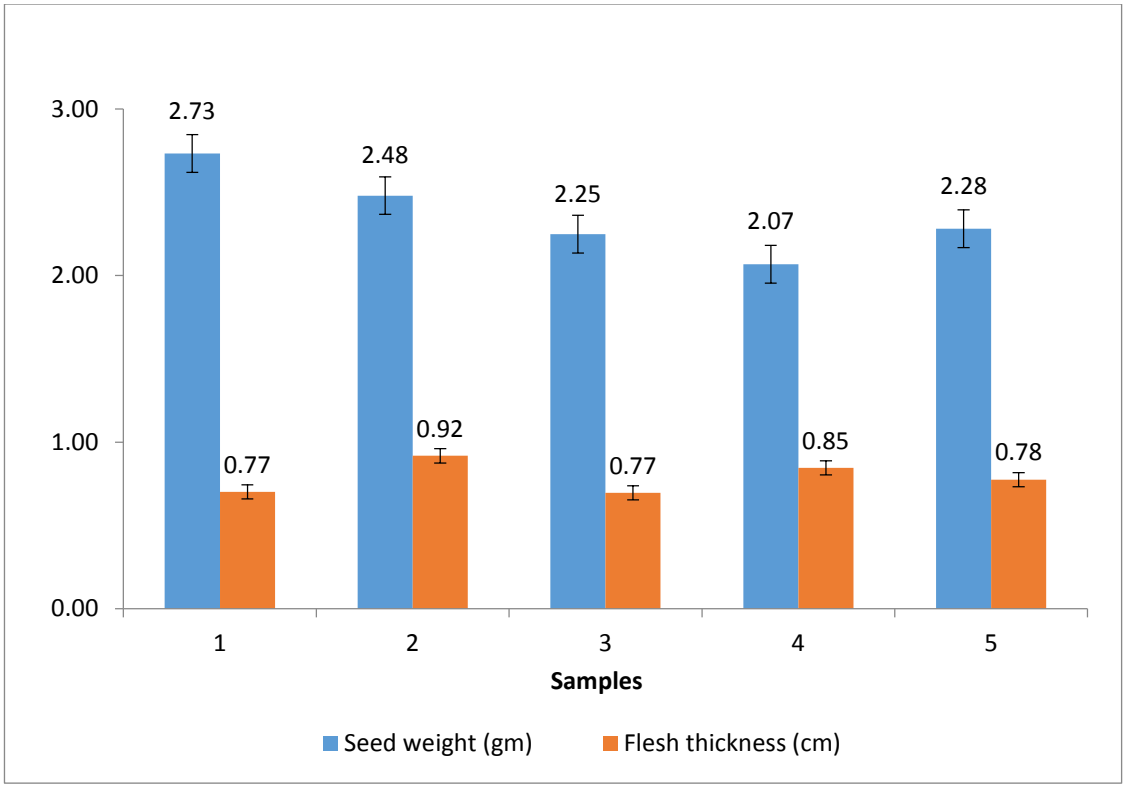

Figure 1. Flesh thickness and seed weight of rambutan *Mutiara Merah*

(d) Flesh weight and brix

The treatments explained the impact on flesh weight shown in Figure 2. Despite this, sample 2 had the greatest body weight measurement of 22.08 gm, followed by samples 1 and 4, and sample 3 had the lowest at 12.63 gm. Figure 2 also depicts the output factors for the flesh brix level as well. The discovered flesh fluid varies significantly when tested for brix level. Sample 5 has the greatest meaningful brix reading of 20.48, followed by samples 4 and 3, and sample 1 has the lowest meaningful reading of 18.24. Rambutan peel extract has the potential to be used as a natural antimicrobial food agent (Phuong et al., 2020). Rainfall, water stress, temperature, and breeze are all important factors in fruit crop output, and current shifts in rainfall trends may influence the flowering and yield of the rambutan (*Nephelium lappaceum* L) (Magdalita & Saludes, 2015). The residual moisture values for the peels of the fruits are higher than that of the seeds due to the greater amount of sugar found in them in comparison to the bitter seeds. The bitter variety showed a higher concentration of bioactive metabolites than the sweet variety and a superior antioxidant capacity (López et al., 2020).

Rambutan fruit extracts are shown to possess phytochemical compounds that have antioxidant, antimicrobial, antidiabetic, antiviral, anti-inflammatory, anti-hypoglycemic and anti-proliferative effects. It is necessary to further analyze the nutritional and functional potential of this fruit and develop its industrial process (Hernández et al., 2019). Browning was preceded by water loss and a decrease in water potential of spinterns and skin, resulting in a loss of membrane permeability, allowing browning to proceed. This was caused by excessive water loss and the development of plasmolysis (Landrigan et al., 1996).

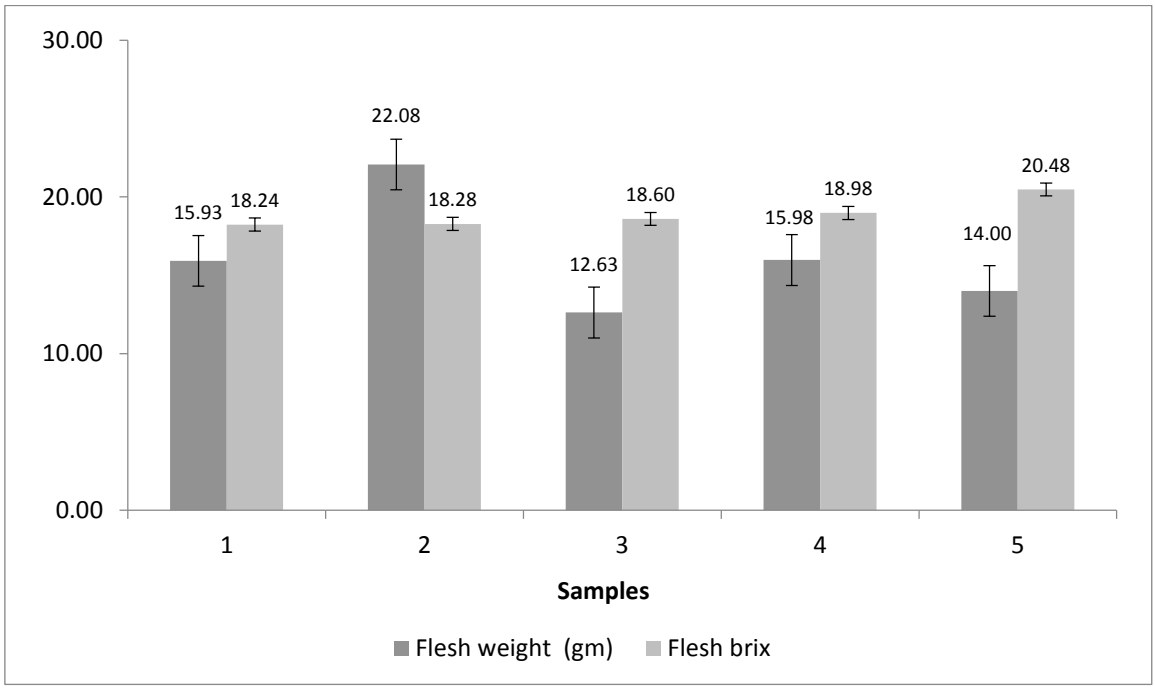

Figure 2. Flesh weight and brix of rambutan *Mutiara Merah*.

(e) Correlation analysis between parameters collected

The findings shown in Table 2 were the strength of the positive relationship between parameters. Fruit weight had a significant positive correlation with fruit diameter, flesh weight, and flesh thickness. However, fruit diameter is significantly positively affected by flesh weight and flesh thickness. Therefore, the flesh weight parameters have the potential effect on the flesh weights of rambutan. The leaflet length, leaflet width and petiole length could be used as specific characters to differ from other cultivars (Windarsih, 2022). Although several leaf morphological characters could be used to distinguish some cultivars from others, there was a possibility those characters also could be found on other cultivars (Windarsih, 2022).

4. Conclusion & Future Recommendations

The results of all parameters indicated a significant link between rambutan yield properties. *Mutiara Merah* showed that it can be planted and farmed effectively on sandy tin-tailing soil, according to the results of the previous research. It can grow and be useful in boosting rambutan yield. Taking into account the fruit yield parameters as well as yield character components parameters such as fruit weight, seed weight, fruit diameter, flesh thickness, brix, and flesh weight, it can be concluded that rambutan cultivation in marginal tin-tailing soil was found promising for producing higher yields. As a result, the finding could assist in the recommendation of rambutan producers in sand-mining ecosystems where chemical fertilizer spending can be optimized. No studies have been published on the effect of tree age on the fruit quality of rambutan. Thus, there is a need for comprehensive research to determine the possible variation in fruit quality in relation to tree age. The research also has drawbacks because knowledge of rambutan cultivation agronomy practices for field stages in Malaysia is restricted. More field studies are needed to standardize agro-techniques and establish the fertilizer requirements of chemical and organic fertilizers for higher yield in other marginal soils such as peat, bris, and acid sulfate soil, as well as create various value-added products to utilize excess produce.

Table 2. Analysis of mean correlation on the yield components of rambutan

Parameters	Fruit weight (gm)	Fruit diameter (cm)	Flesh weight (gm)	Seed weight (gm)	Flesh brix	Flesh thickness (cm)
Fruit weight (gm)	1	0.79	0.83	0.16	-0.13	0.65
		**	**	ns	ns	**
Fruit diameter (cm)		1	0.55	-0.26	-0.01	0.56
			*	ns	ns	**
Flesh weight (gm)			1	0.24	-0.26	0.65
				ns	ns	**
Seed weight (gm)				1	-0.13	-0.12
					ns	ns
Flesh brix					1	0.12
						ns
Flesh thickness (cm)						1

Note: mean along with * shows the significant difference at $p < 0.05$, mean along with ** shows the significant difference at $p < 0.01$.

Declarations

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This study did not receive any grant from funding agencies in the public or not-for-profit sectors.

Competing Interests Statement

The authors have declared no competing interests.

Consent for Publication

The authors declare that they consented to the publication of this research work.

Author's Contribution

All the authors took part in data collection, research and manuscript writing equally.

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References

[1] Augustin, M.A., & Chua, B.C. (1988). Composition of Rambutan Seeds. Pertanika, 11(2): 211-5. http://psasir.upm.edu.my/id/eprint/2559/1/composition_of_rambutan_seeds.pdf (Accessed: 30 March 2023).

[2] Bhattacharjee, P., Das, S., Das, S.K., & Chander, S. (2022). Rambutan (*Nephelium lappaceum* L.): A potential fruit for industrial use, serving nutraceutical, livelihood interests and enhancing climate resilience. South African Journal of Botany, 150: 26-33. doi: https://doi.org/10.1016/j.sajb.2022.06.064.

[3] Goenaga, R., & Jenkins, D. (2011). Yield and Fruit Quality Traits of Rambutan Cultivars Grafted Onto A Common Rootstock and Grown at Two Locations in Puerto Rico. Horttechnology, 21(1): 136-140. doi: https://doi.org/10.21273/horttech.21.1.136.

[4] Hernández-Hernández, C., Aguilar, C.N., Rodríguez-Herrera, R., Flores-Gallegos, A.C., Morlett-Chávez, J., Govea-Salas, M., & Ascacio-Valdés, J.A. (2019). Rambutan (*Nephelium lappaceum* L.): Nutritional and functional properties. Trends in food Science & Technology, 85: 201-210. doi: https://doi.org/10.1016/j.tifs.2019.01.018.

[5] Johari, S., Zulhazmi, S., Salehudin, M.R., Norhanis, A.Y., Suhana. S., Nordalilah, N., Nuratiqah, M.K., Muhammad Zulfa, M.R., Noraisah, R., Jamaludin, K. & Noorfatimah, G (2021). Penanaman Dan Pengeluaran Rambutan *Mutiara Wangi* Dan *Mutiara Merah*. Manual Teknologi. Malaysian Agriculture and Development Institute (MARDI), 41 Pages (Accessed: 30 March 2023).

[6] Karunakaran, G., Tripathi, P.C., Sakthivel, T., Ravishankar, H., Sankar, V., Kumar, R.S., & Mala, B.J. (2016). Rambutan is a Potential Future Fruit. Indian Horticulture, 61(2): 3-5. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=o4dtudwaaaaj&cstart=20&pagesize=80&citation_for_view=o4dtudwaaaaj:k3lrdlh-meoc (Accessed: 3rd March 2023).

[7] Khairol, I., Fadzlirahimi, I., Nordin, M.A., Muhammad Akmal, M.S. & Nor Hadijah. A. (2023). Preliminary Evaluation on Vegetative of Rambutan (*Nephelium Lappaceum*) in Sandy Tin-Tailing Soil. Asian Journal of Applied Science and Technology, 7(1): 34-40. doi: https://doi.org/10.38177/ajast.2023.7104.

[8] Landrigan, M., Morris, S.C., Eamus, D., & Mc Glasson, W.B. (1996). Postharvest water relationships and tissue browning of rambutan fruit. Scientia Horticulturae, 66(3-4): 201-208. doi: https://doi.org/10.1016/S0304-4238(96)00915-6.

[9] López, L.L.V., Guaranda, I.A.C., Lavid, G.A.C., & Martínez, M.M. (2020). Pharmacognostic study and evaluation of the antioxidant capacity of the fruit of two varieties of *Nephelium lappaceum* L. (Sapindaceae), (rambutan). J. Pharm. Pharmacogn. Res., 8: 64-77. https://d1wqtxts1xzle7.cloudfront.net/61405032/jppres19.701_8.1.64-libre.pdf?1575354468=&response-content-disposition=inline%3B+filename%3DPharmacognostic_study_and_evaluation_of.pdf&Expires=1682559378&Signature=eTy6SSXGmuBcRoCa1ggafnr7dvyDDCqcIwskCgLqi6yPZskozApS-7qmRdg8HlH~6U~CKWj3FdJYbxbfSNvtGINuvybeoVxtPZcFFFZm2PJQ0KXS-Q-pteVlbBYW7NzszBzWXU6GusbaHRyqsLNs~zGc2QQnoHPujTsU5HwAumlaVppgUS8F2gfX1VaDtG39ughpibeBQwJUN

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[10] Magdalita, P.M., & Saludes, R.B. (2015). Influence of changing rainfall patterns on the yield of Rambutan (*Nephelium Lappaceum* L.) and selection of genotypes in known drought-tolerant fruit species for climate change adaptation. Science Diliman, 27(1). https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Influence+of+changing+rainfall+patterns+on+the+yield+of+Rambutan+%28Nephelium+Lappaceum+L.%29+and+selection+of+genotypes+in+known+drought-tolerant+fruit+species+for+climate+change+adaptation&btnG= (Accessed: 30 March 2023).

[11] Phuong, N.N.M., Le, T.T., Van Camp, J., & Raes, K. (2020). Evaluation of antimicrobial activity of rambutan (*Nephelium lappaceum* L.) peel extracts. International Journal of Food Microbiology, 321: 108539. doi: https://doi.org/10.1016/j.ijfoodmicro.2020.108539.

[12] Pohlan, J., Vanderlinden, E.J., & Janssens, M.J. (2008). Harvest Maturity, Harvesting and Field Handling of Rambutan. Stewart Postharvest Review, 2(11): 1-12. doi: https://doi.org/10.2212/spr.2008.2.11.

[13] Putri, I.I.S., Yuniastuti, E., & Parjanto, P. (2022). The Rambutan (*Nephelium Lappaceum* L.) Chromosomes. Biodiversitas Journal of Biological Diversity, 23(4). doi: https://doi.org/10.13057/biodiv/d230455.

[14] Rashied, T., Aboagye, L.M., Osafo, E.A., Darko, R., Dassah, A., & Obirih-Opareh, J. (2022). Effect of tree age on fruit characteristics, seed emergence and seedling growth in Rambutan (*Nephelium lappaceum* L.). Journal of Horticultural Sciences, 17(1): 245-248. doi: https://doi.org/10.24154/jhs.v17i1.991.

[15] Sun, X., Wall, M., Follett, P., Liang, P., Xu, S., & Zhong, T. (2023). Effect of Pectin Coatings Containing Trans-cinnamaldehyde on the Postharvest Quality of Rambutan. Hort Science, 58(1): 11-15. doi: https://doi.org/10.21273/hortsci16923-22.

[16] Tripathi, P.C., & Karunakaran, G. (2013). Rambutan Cultivation. Principal Scientist (Hort.) & Head. https://www.researchgate.net/profile/prakash-tripathi-2/publication/303803424_rambutan_cultivation/links/5753059d08ae02ac127923f8/rambutan-cultivation.pdf (Accessed: 30 March 2023).

[17] Tripathi, P.C., Karunakaran, G., Sakthivel, T., Sankar, V., & Senthil Kumar, R. (2014). Rambutan Cultivation In India. Technical Bulletin, 1(2014): 18. https://www.researchgate.net/profile/prakash-tripathi-2/publication/304351265_rambutan_is_a_potentail_future_fruit/links/5f67022b458515b7cf4188aa/rambutan-is-a-potentail-future-fruit.pdf (Accessed: 29 March 2023).

[18] Tsong, J.L., Goh, L.P.W., Gansau, J.A., & How, S.E. (2021). Review of *Nephelium lappaceum* and Nephelium ramboutan-ake: a high potential supplement. Molecules, 26(22): 7005. doi: https://doi.org/10.3390/molecules26227005.

[19] Vanderlinden, E.J.M., Pohlan, H.A.J., & Janssens, M.J. (2004). Culture and fruit quality of Rambutan (*Nephelium Lappaceum* L.) in the Soconusco Region, Chiapas, Mexico. Fruits, 59(5): 339-350. doi: https://doi.org/10.1051/fruits:2004032.

[20] Windarsih, G. (2022). Characterization of Leaf Morphology on Several Rambutan (*Nephelium Lappaceum*) Cultivars from Serang City, Banten, Indonesia. In Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia, 8(1). doi: https://doi.org/10.13057/psnmbi/m080103.

[21] Yuniastuti, E., Chintiana, D.G., & Putri, I.I.S. (2022). Effect of NAA and BAP concentrations on rambutan growth (*Nephelium lappaceum* L.) in Vitro. In IOP Conference Series: Earth and Environmental Science, 1107(1): 012029. doi: https://doi.org/10.1088/1755-1315/1107/1/012029.